

Three New Species of *Pilocarpus* Vahl (Rutaceae) from Brazil

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ABSTRACT. As a result of a revision of *Pilocarpus* Vahl (Rutaceae), three new species of *Pilocarpus* Vahl (Rutaceae) from Brazil are described and illustrated: *Pilocarpus alatus* C. J. Joseph ex Skorupa, *Pilocarpus carajaensis* Skorupa, and *Pilocarpus sulcatus* Skorupa. Data on the geographic distribution, habitat, and phenology are given for all the new taxa.

Pilocarpus is a neotropical genus described by Vahl (1797), encompassing shrubs or small trees occurring from the south of Mexico through Central America and the Lesser Antilles and Greater Antilles to the south of South America. The majority of the species occur in Brazil, where they are found in habitats characterized by various climatic conditions, soils, and vegetation types throughout the country.

Skorupa's (1996) revision of *Pilocarpus* recognized 16 species, including three new species in Brazil. This revision took into consideration not only morphology, as did Kaastra (1982), but also wood anatomy, *n*-alkane distribution patterns of foliar epicuticular waxes, chromosome numbers, and pollen morphology as additional sources of taxonomic evidence.

Pilocarpus alatus C. J. Joseph ex Skorupa, sp. nov. TYPE: Brazil. Pará: Peixe Boi, Estação Experimental de Peixe Boi, E. de F. de Bragança, 21 Oct. 1926, *Ducke s.n.* (holotype, RB 20477). Figure 1A–I.

Folia imparipinnata, (2–)3–4(–5)-juga; lamina 3.3–17.0 × 1.5–7.5 cm, anguste elliptica anguste oblonga vel lanceolata, apice acuminato; petiolo cum rhachidi alato. Flores sessiles; calyce lobulis inaequalibus, rotundis vel triangularibus, valvatis; corolla valvata, 6.5–7.0 mm diam., petalis castaneis extus puberulis; filamentis paulo subulatis, apice obtuso; stigmatibus capitato dilatato, ovario pubescente. Fructus ex 1–5 coccis constans; seminibus nigris.

Shrubs to small trees, 1.5–6.0 m tall; trunk cinereous or brownish, 3.0–5.0 cm diam.; terminal branchlets 3.0–6.0 mm diam., brown or cinereous, glabrous or glabrescent, terminal buds protected by cataphylls, the cataphyll 2.5–4.0 mm long, trian-

gular or oblong, pubescent. Leaves imparipinnate, (2–)3–4(–5)-jugate, alternate, 13.5–35.0 × 8.5–31.0 cm, distance between pairs 2.5–7.0 cm, rachis 4.5–18.5 cm long, pubescent, winged, the wings 0.2–0.4 mm broad, broader toward leaflets; petiole 25.0–90.0 × 1.0–2.0 mm, pubescent above and glabrous beneath, winged, the wings 0.2–0.4 mm broad, the petiole often slightly canaliculate by wings, inserted at ca. 45° (ca. 90° in field); lateral leaflets opposite, the lowermost subopposite, the blade 3.3–17.0 × 1.5–7.5 cm, narrowly elliptic to elliptic, narrowly oblong or lanceolate, acuminate at apex, the acumen 4.0–15.0(–20.0) mm, subacuminate or acute, the base attenuate, acute or obtuse, usually asymmetric, dark green and shining above, paler beneath, chartaceous, the adaxial surface minutely pubescent on midvein or glabrescent, the abaxial surface glabrous, the margin revolute; venation brochidodromous, the midvein prominent on both sides, the secondary veins 12–17 pairs, angle of divergence 65–75°; petiolule 0–2.5 × 1.0–1.5 mm, inserted at 35–45°, pubescent, winged, the wings ca. 0.2 mm broad; terminal leaflet blade 3.0–20.5 × 1.0–9.0 cm, lanceolate or narrowly elliptic, acuminate at apex with acumen to 10.0 mm, or subacuminate, attenuate or acute at base; petiolule 2.0–20.0 × 1.0–1.5 mm, winged, the wings 0.2–0.9 mm broad, frequently tapering toward base, the margin pubescent. Raceme terminal or subterminal, erect, to 25.0 cm long and 6.5–7.5 cm wide at anthesis, the rachis 2.0–3.0 mm thick at base, dark brown, minutely pubescent; bracts at base 2–4, narrowly triangular, ca. 3.5 mm long, pubescent, ferruginous; flowers sessile, inserted at 90° or slightly inclined toward apex of the raceme; floral bract 1, ca. 0.3 × 0.6 mm, triangular with acute apex, pubescent, ciliolate; bractlets 2, subopposite, 0.3–0.6 × 0.4–0.6 mm, triangular with acuminate apex, pubescent, ciliolate. Calyx (4–)5-lobed, the lobes valvate, joined to middle, unequal, the larger rounded and the smaller triangular with obtuse apex, 0.5–0.9 × 1.3–1.7 mm, pubescent, ciliolate; corolla 6.5–7.0 mm diam., valvate; petals (4–)5, 2.4–2.8 × 2.0–2.2 mm, ovate, pale brown to greenish, pubescent outside, the apex inflexed through

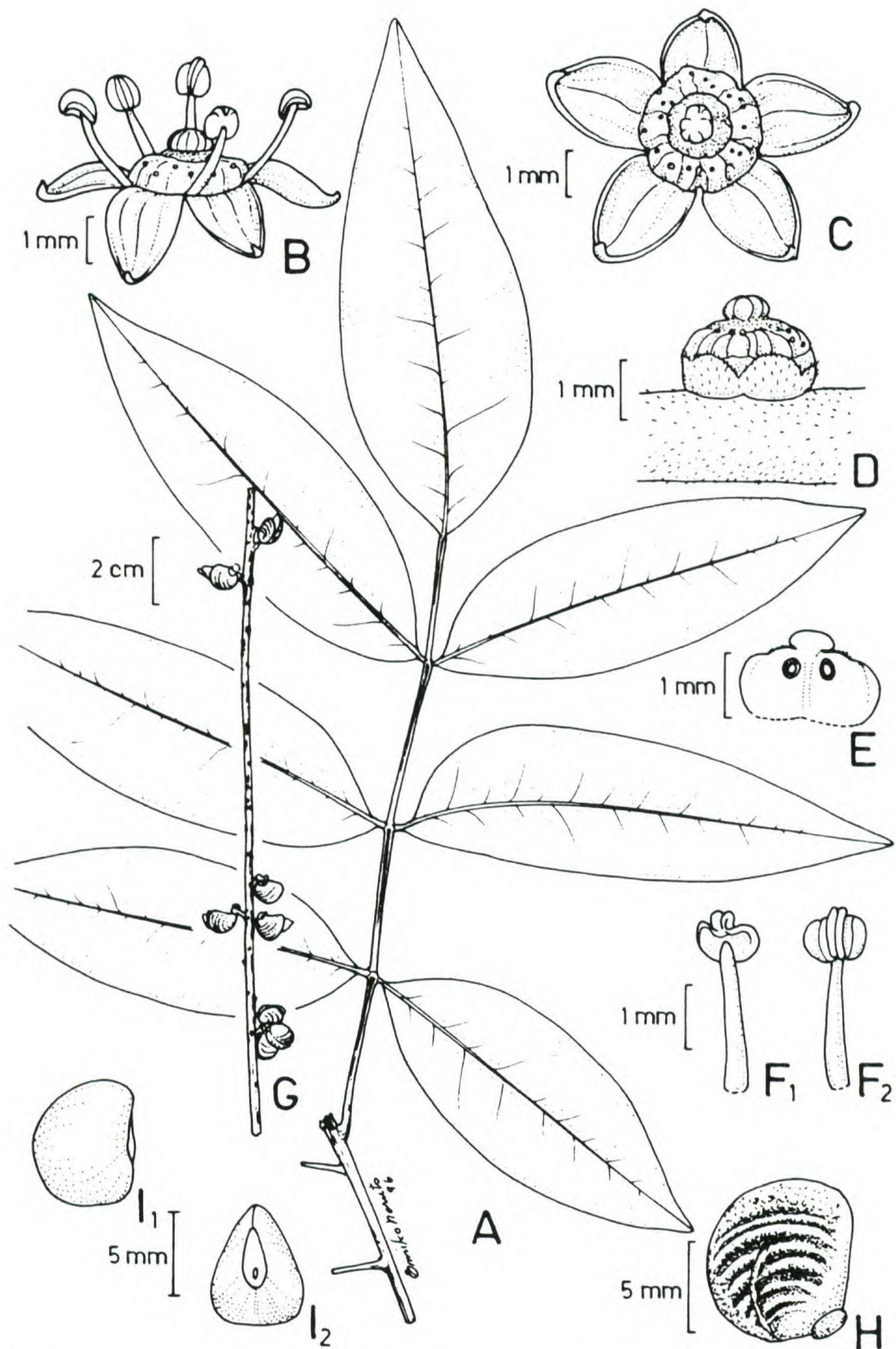


Figure 1. *Pilocarpus alatus* C. J. Joseph ex Skorupa (Skorupa & Silva 1024, CEN). —A. General aspect of the branch. —B. Flower, lateral view. —C. Flower, upper view, without stamens. —D. Flower, lateral view, without petals and stamens. —E. Ovary, longitudinal section. —F₁ and F₂. Stamens, dorsal and frontal view. —G. Rachis with mericarps. —H. Mericarp, lateral view. —I₁ and I₂. Seed, lateral and ventral view.

0.3 mm, venation subparallel, the median nerve thicker; stamens (4–)5, filaments $2.1\text{--}2.2 \times \text{ca. } 0.4$ mm, flattened, slightly subulate with obtuse apex, glabrous, pale brown, anthers $0.7\text{--}0.9 \times \text{ca. } 0.9$ mm, ovate, recurved, with a dorsal narrowly elliptic gland ca. 0.1 mm long, inconspicuous; disk 15-plicate, ca. 0.5 mm high and $2.6\text{--}2.8$ mm diam., yellowish with conspicuous dark glands, glabrous or puberulent at apex; carpels (4–)5, the ovary ca. 0.7 mm high, 10-plicate, protruding 0.3 mm beyond disk, pale brown, minutely pubescent, with yellowish trichomes; ovule 1 per carpel; style ca. 0.5 mm, protruding ca. 0.1 mm beyond ovary; stigma capitate, dilated, ca. $0.5 \times 0.8\text{--}1.0$ mm, (4–)5-lobate. Mericarps 1–5, $9.0\text{--}11.0 \times 7.5\text{--}9.5$ mm, obovoid, dorso-apically rounded to an oblique apex, magenta becoming brownish, pubescent or glabrescent, dark glands inconspicuous, the line of dehiscence reaching to $\frac{1}{3}\text{--}\frac{2}{3}$ of distance to apex, longitudinally striate from base to apex on both sides, pedicels 1.5–3.0 mm long in fruit; seeds $7.0\text{--}7.5 \times 5.5\text{--}6.0$ mm, ellipsoid to ovoid, the testa black, the hilum $2.5\text{--}3.5 \times 1.1\text{--}1.3$ mm, ovate to lanceolate.

Phenology. Found with scarce flowering in March; collected in fruit in October and March.

Distribution. Known only from two localities: Lago do Junco in the State of Maranhão and Peixe Boi in the State of Pará, growing in dense forest up to 160 m.

The new species resembles *Pilocarpus microphyllus* Stapf ex Wardleworth, due to its winged rachis, petiolule and petiole alate, and its capitate stigma dilated at the apex. However, *P. microphyllus* differs from *P. alatus* by its smaller leaves and leaflets, the leaflets sessile with an obtuse, rounded and emarginate apex, its pedicellate greenish flowers, subulate filaments, and its reduced and sub-orbicular anther.

Pilocarpus alatus was published by Joseph (1967) in a magazine called *Mecânica Popular*, which deals generally with scientific curiosities and machine repair. Joseph (1967) presented the new taxon based on *Ducke s.n.*, deposited in RB, with vegetative branches, mericarps, and seeds. Kaastra (1982) did not refer to Joseph's work in his revision of *Pilocarpinae*, most probably due to the low circulation of the article in research center libraries. For some reason, Kaastra did not have access to the holotype of *P. alatus* and thus did not consider the taxon in his revision. As a consequence, the taxon has remained forgotten for three decades.

The original description of *P. alatus* provides a diagnosis in Latin and designation of the type. However, it conflicts with articles 29.1 and 30.3 of

the *International Code of Botanical Nomenclature* (Greuter et al., 1994). According to these articles Joseph's name is not effectively published because it was published in a magazine not distributed to libraries accessible to botanists generally.

Paratypes. BRAZIL. **Maranhão:** Lago do Junco, Fazenda Bacaba, 5 km S from entrance of MA 119, 3 km NW of Lago do Junco, $4^{\circ}26'S$, $44^{\circ}58'W$, 04 Oct. 1980, *Daly et al.* 465 (HRB, IAN, SPF); ca. 6 km NW of Lago do Junco, $4^{\circ}27'S$, $44^{\circ}56'W$, 160 m, 20 Mar. 1995, *Skorupa & Silva* 1024 (CEN).

Pilocarpus carajaensis Skorupa, sp. nov. TYPE: Brazil. Pará: Parauapebas, Carajás, antigo Zoobotânico, 2.5 km do Aeroporto de Carajás, $5^{\circ}37'S$, $50^{\circ}37'W$, 20 m, 22 May 1992, *L. A. Skorupa & Elzamar* 996 (holotype, CEN; isotypes, CEN, G, GH, K, MICH, MO, NY, P, RB, SPF, US). Figure 2A–H.

Folia vulgo simplicia vel unifoliolata raro bifoliolata vel trifoliolata; lamina anguste elliptica, apice acuminato, acumine retuso. Flores virides, breviter pedicellati, pedicellis 0.5–1.5 mm longis, subangulo ca. 45° rhachidi insertis. Fructus plerumque ex coccis 1 vel 2 constans, cocci $9.5\text{--}12.0 \times 8.0\text{--}11.0$ mm, paulo complanatis; seminibus vinaceis quasi nigris, $7.5\text{--}9.0 \times 5.5\text{--}7.5$ mm.

Shrubs, small trees, or trees, 1.5–7.0 m tall; trunk cinereous, 5.5–7.0 cm diam.; terminal branchlets 2.0–3.5 mm diam., brown or cinereous, glabrescent, terminal buds protected by cataphylls, the cataphyll 1.0–4.0 mm long. Leaves usually simple or unifoliolate, rarely bifoliolate or trifoliolate with 1 or 2 basal leaflets reduced respectively, alternate, subopposite or subverticillate; petiole $3.0\text{--}25.0(-38.0) \times 1.0\text{--}2.5$ mm, inserted at $30\text{--}55^{\circ}$, glabrous, slightly canaliculate by wings, the wings 0.4–0.6 mm broad; blade $6.0\text{--}23.5 \times 1.5\text{--}6.5$ cm, narrowly elliptic, rarely obovate to narrowly obovate or lanceolate, subacuminate or acuminate at apex, the acumen to 23.0 mm long, retuse, the base attenuate to narrowly attenuate, dark green above and paler beneath, chartaceous, glabrous, the margin entire, revolute; venation brochidodromous, the midvein prominent on both sides, the secondary veins 17–20(–24) pairs, angle of divergence $60\text{--}75^{\circ}$. Raceme terminal, rarely lateral, pendulous, 17.5–52.0 cm long and 0.7–0.8(–1.2) cm wide at anthesis, the rachis 1.0–3.0 mm thick at base, greenish, pubescent, rarely glabrous; bracts at base 4 or 5, narrowly triangular or falciform, $2.0\text{--}6.0 \times 0.8\text{--}1.5$ mm, strigose; pedicels 0.5–1.5 mm long, inserted at ca. 45° to the rachis, glabrous; floral bract 1, $0.4\text{--}0.9 \times 0.3\text{--}0.4$ mm, triangular with acuminate apex, glabrous, ciliolate; bractlets 2, subopposite, $0.5\text{--}0.8 \times 0.5\text{--}1.0$ mm, triangular

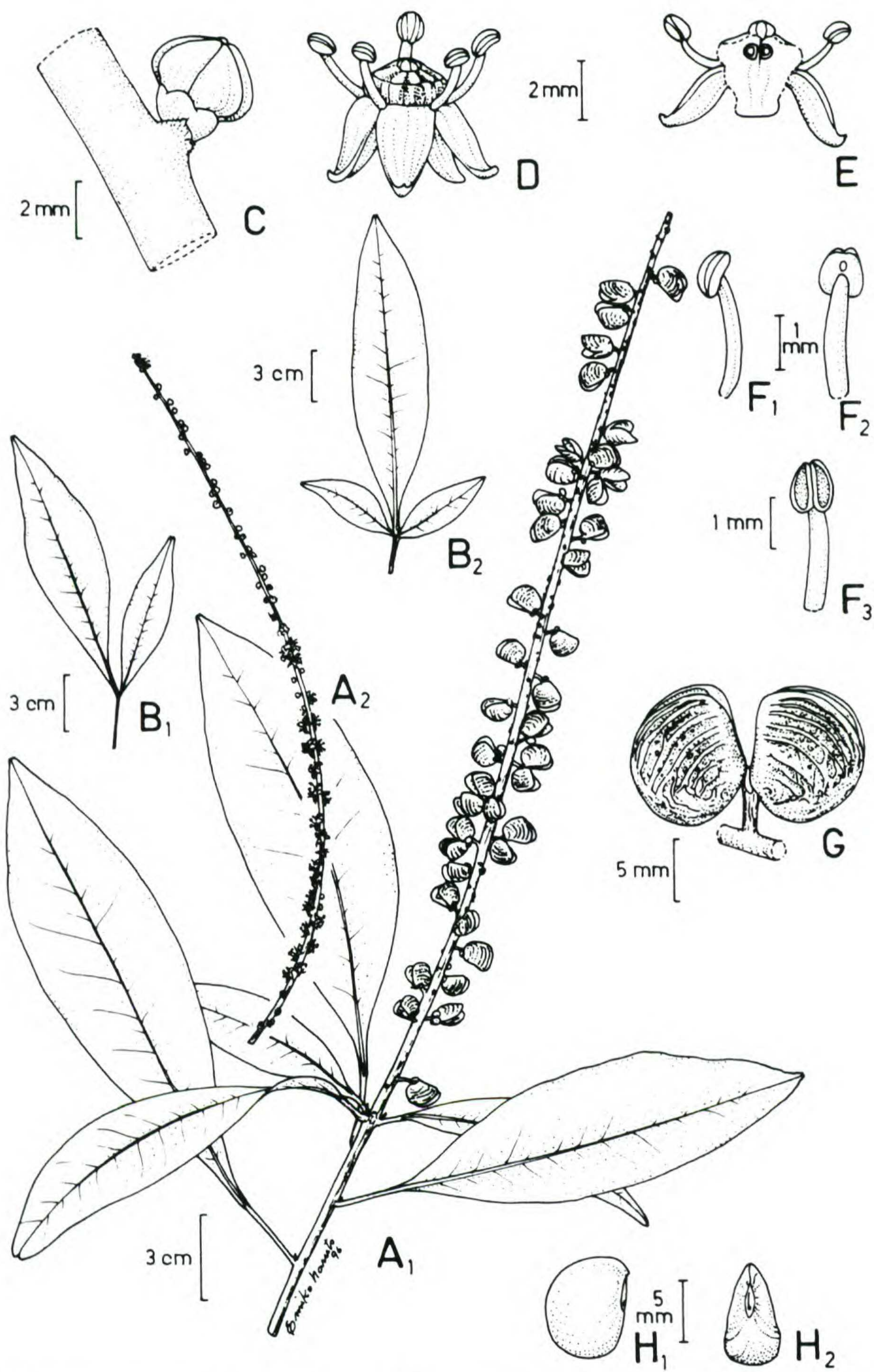


Figure 2. *Pilocarpus carajaensis* Skorupa (Skorupa & Elzamar 996, CEN). —A₁. Branch with fruits. —A₂. Inflorescence. —B₁. Bifoliolate leaf. —B₂. Trifoliolate leaf. —C. Bud, lateral view. —D. Flower, lateral view. —E. Flower in longitudinal section. —F₁, F₂, and F₃. Stamens, lateral, dorsal, and frontal view. —G. Mericarps, lateral view. —H₁ and H₂. Seed, lateral and ventral view.

with acuminate apex, glabrous, ciliolate; calyx (4–)5-lobate, the lobes reduced, ovate, $0.4\text{--}0.8 \times 0.7\text{--}1.0$ mm, glabrous, ciliolate; corolla $6.0\text{--}7.5$ mm diam., aestivation quincuncial to subvalvate; petals (4–)5, $2.5\text{--}3.1 \times 1.5\text{--}1.9$ mm, lanceolate to ovate, green or yellowish green with dark glands, glabrous, the apex inflexed through $0.3\text{--}0.6$ mm, venation subactinodromous; stamens (4–)5, filaments $1.9\text{--}2.2 \times 0.3\text{--}0.4$ mm, subterete, flattened toward base, the apex obtuse or truncate, glabrous, yellowish green, anthers $1.1\text{--}1.3 \times 0.8\text{--}1.1$ mm, recurved, ovate, dorsal gland elliptic or ovate, ca. 0.3×0.2 mm; disk 15-plicate, $0.3\text{--}0.8$ mm high and $1.5\text{--}2.6$ mm diam., glabrous or with occasional trichomes; carpels (4–)5, the ovary $0.7\text{--}0.8$ mm high, 5-plicate, protruding $0.2\text{--}0.3$ mm beyond disk, pale green, glabrous; ovule 1 per carpel; style ca. 0.4 mm inserted among lobes of carpels; stigma capitate, $0.4\text{--}0.5 \times 0.5\text{--}0.8$ mm, (4–)5-lobate. Mericarps usually 1 or 2, $9.5\text{--}12.0 \times 8.0\text{--}11.0$ mm, obovoid, complanate, dorso-apically rounded to an oblique apex, brown, glabrous with conspicuous brown glands becoming dark, the line of dehiscence reaching to $\frac{1}{2}\text{--}\frac{2}{3}$ of distance to apex, pedicels $1.5\text{--}4.5$ mm long in fruit; seeds $7.5\text{--}9.0 \times 5.5\text{--}7.5$ mm, ovate to elliptic, testa vinaceous to black, the hilum $2.3\text{--}2.8(3.4) \times 0.5\text{--}1.2$ mm, lanceolate to narrowly elliptic.

Phenology. Flowering from March to May; collected in fruit from March to July.

Distribution. Restricted to the Carajás region, State of Pará, growing in dense forest up to 500 m.

Evidence of the new taxon was obtained initially through analysis of specimens from IAN and INPA, it being frequently named on labels as *Pilocarpus itacaiunensis*. These specimens were not analyzed by Kaastra (1982), which is somewhat surprising considering that these specimens were collected a long time ago, first in 1948 (Fróes 23394), and again in 1949, 1951, 1970, and 1980.

Pilocarpus carajaensis usually has simple or unifoliate leaves, characterized by the occurrence of a conspicuous articulation at the apex of the petiole, or occasionally bifoliate or trifoliate leaves with one or two reduced leaflets, respectively. Bifoliate and trifoliate leaves are rare in herbarium specimens, but frequently observed in the field; this anomaly is most probably due to the rarity of such leaves on floral branches, which are usually collected.

Pilocarpus racemosus Vahl also has a great variety of foliar types: simple, unifoliate, or up to 3-jugate. However, its leaflets usually have an obtuse or rounded (rarely subacuminate) apex. The

floral morphology of *P. racemosus* is rather different, with vinaceous to purpureous petals, a clavate stigma and subulate filaments with acute apices, the filaments surrounded at base by a disk. *Pilocarpus racemosus* has an allopatric distribution, occurring from Venezuela up to southern Mexico.

Other taxa that somewhat resemble *Pilocarpus carajaensis* are *P. spicatus* A. Saint-Hilaire var. *spicatus* and *P. peruvianus* (Macbride) Kaastra. *Pilocarpus spicatus* shares with *P. carajaensis* narrowly elliptic leaves with an acuminate apex, greenish flowers with strongly reflexed petals at anthesis, and truncate filaments. However, *P. spicatus* has only simple leaves, pedicels inserted at 90° on the rachis, frequently sessile flowers, and smaller mericarps. *Pilocarpus spicatus* has an allopatric distribution, occurring mainly on the eastern side of Brazil.

Pilocarpus peruvianus also has leaves with an acuminate or eventually retuse apex, greenish flowers with strongly reflexed petals at anthesis, and pedicels inserted at 45° on the rachis. However, this taxon differs from *P. carajaensis* by its always simple leaves with a strongly bullate lamina. Its mericarps are larger with a rounded to semitruncate apex, and its seeds are pale brown. *Pilocarpus peruvianus* has an allopatric distribution, occurring in Peru, Bolivia, and Brazil in Acre, Rondônia, and Mato Grosso States.

The specific epithet “*itacaiunensis*,” coined but not published by J. M. Pires, was not adopted here considering the wider geographic distribution of the taxon in the Carajás region and not only in the vicinity of the Itacaiúnas River as the epithet suggests.

Paratypes. BRAZIL. **Pará:** Altamira, Igarapé Ipixuma, $4^\circ49'S$, $52^\circ31'W$, 21 Mar. 1986, Balée 2001 (NY). **Marabá:** Rio Itacaiúnas, entre B2 and B3, $5^\circ31'S$, $50^\circ13'W$, 09 July 1970, Pires & Belém 12419 (IAN); Carajás, Serra Norte, 31 May 1983, Silva et al. 1403 (HRB, MG); entre Caldeirão e Salobro, 29 July 1983, Silva et al. 1572 (MG); Rio Vermelho, Remansinho, 05 Sep. 1948, Fróes 23394 (IAC, IAN); região do Tocantins, 23 Apr. 1951, Fróes 26975 (IAN); área de Bertholetia, 01 May 1951, Fróes 27029 (IAN); Viraçãozinha, 13 June 1949, Fróes & Black 24472 (IAC, IAN); Parauapebas, Carajás, AMZA 3-alfa, $5^\circ48'S$, $50^\circ33'W$, 300–475 m, 08 June 1982, Spelling et al. 5971 (GH, NY); Chácara dos Chagas, $6^\circ04'S$, $49^\circ54'W$, 22 May 1992, Skorupa 997 (CEN); Castanhal Jatobal PVF-17, 13 July 1990, Rosa 5277 (MG); próximo ao N1, 20 May 1982, Secco et al. 280 (NY); Tucuruí, Fazenda Guaripé, 13 May 1980, Rosa 3668 (INPA, NY). Unknown place: July 1970, Pires & Belém 12580 (US).

Pilocarpus sulcatus Skorupa, sp. nov. TYPE: Brazil. Bahia: Tanque Novo, a 10 km de Tanque Novo rumo a São José, no alto da pedreira (ca. 1 km), 13°32'S, 42°29'W, alt. 835 m, 16 Mar. 1994, L. A. Skorupa 1012 (holotype, CEN; isotypes, CEN, K, MICH, MO, NY, RB, SPF). Figure 3A–H.

Folia simplicia; lamina 3.0–12.5 × 1.0–6.0 cm, anguste elliptica vel anguste oblonga vel subinde oblanceolata, subtus dense pubescente, supra glabra vel nervo medio marginibusque pubescentibus, supra nervis conspicue sulcatis. Flores subsessiles; corolla 6.0–8.0 mm diam.; calyce lobulis extus strigulosus; petalis castaneis extus pubescentibus. Fructus plerumque ex cocco unico constans; cocco 5.5–8.0 × 5.5–7.5 mm.

Shrubs to small trees, 1.0–4.0 m tall; trunk cinereous, 4.0–6.0 cm diam., branched near base; terminal branchlets 3.5–6.0 mm diam., cinereous or slightly vinaceous, pubescent or glabrous, terminal buds protected by cataphylls, the cataphyll 2.5–5.0(–10.0) mm long, narrowly triangular to narrowly oblong, strigose, ferrugineous. Leaves simple, alternate or subverticillately crowded toward apex of branchlets; petiole 3.0–10.0(–14.0) × 1.0–2.0 mm, inserted at 35–55°, pubescent, slightly winged, the wings up to 0.3 mm broad; blade 3.0–12.5 × 1.0–6.0 cm, narrowly elliptic or narrowly oblong or oblanceolate, the apex rounded, obtuse, or emarginate, the base attenuate, dark green above and paler beneath, opaque, subcoriaceous, the adaxial surface glabrous or pubescent at margins and along midrib, the abaxial surface pubescent, the margin entire, strongly revolute; venation brochidodromous, the veins with sulcate surface on adaxial side, prominent on abaxial side, the secondary veins 11–15 pairs, angle of divergence 45–55°. Raceme terminal, erect, 9.0–18.0(–33.0) cm long and 0.7–0.8 cm wide at anthesis, the rachis 1.5–3.0 mm thick at base, strongly pubescent, the trichomes ferruginous or paler; bracts at base caducous, occasionally persistent, triangular, ca. 1.5 × 3.0 mm, pubescent, ferruginous; pedicels 0.2–0.5 mm long, inserted at 90° to the rachis or slightly inclined toward apex of raceme, pubescent; floral bract 1, 0.6–1.0 × 0.4–1.0 mm, triangular with acute apex, strigillose, ciliolate; bractlets 2, subopposite, 1.0 × 0.9 mm, triangular with acuminate apex or widely ovate, strigillose, ciliolate; calyx 5-lobed, the lobes separate, quincuncial, 0.8–1.4 × 1.1–1.6 mm, unequal, ovate to widely ovate, rounded or obtuse at apex, strigillose and ciliolate; corolla 6.0–8.0 mm diam., subvalvate; petals 5, 2.5–3.0 × 2.0–2.4 mm, ovate to broadly ovate, coriaceous, nut-brown, densely pubescent outside, the apex inflexed through 0.5–0.6 mm, venation subparallel; stamens 5, filaments

2.8–2.9 × ca. 0.3 mm, flattened, ± subulate with apex acute or obtuse, glabrous, pale brown, anthers 0.9–1.0 × 0.7–0.8 mm, ovate or elliptic, the dorsal gland suborbicular, 0.3–0.4 × 0.2–0.3 mm; disk 0.8–1.0 mm high and 3.0–3.2 mm diam., glabrous; carpels 5; ovary 1.2–1.4 mm high, protruding ca. 0.4 mm beyond disk, strigillose, the trichomes ferruginous or paler; ovules 1 per carpel; style ca. 0.5 mm; stigma capitate, 0.6–0.7 × 0.7–0.8 mm, 5-lobate. Mericarps 1 or rarely 2, 5.5–8.0 × 5.5–7.5 mm, obovoid, dorso-apically rounded or apex semitruncate, pubescent, vinaceous glands becoming dark, line of dehiscence reaching to ¼ of distance from apex; pedicels ca. 1.5 mm long in fruit; seeds not seen.

Phenology. Flowering specimens collected from March to June and fruiting specimens from January to March.

Distribution. Relatively restricted, this species occurs in southern Bahia and northern Minas Gerais, on lateritic soils from 520 to 850 m.

Pilocarpus sulcatus differs from other taxa by some remarkable features, the first of them being the conspicuously sulcate veins on the adaxial leaf surface, a character only slightly developed in *P. riedelianus* Engler and *P. trachylophus* Holmes. Its flowers have densely pubescent calyces and corollas, and the leaves are pubescent on the abaxial surface and frequently also on the margins and midrib on the adaxial surface. *Pilocarpus spicatus* A. Saint-Hilaire subsp. *longeracemosus* (Martius ex Engler) Kaastra has a similar pilosity, but it has greenish flowers with conspicuous pedicels and filaments subulate with an acute apex.

Unlike any other species in the genus, *P. sulcatus* has a great capacity for vegetative propagation, characterized by stolon-like organs that run horizontally and shallowly under the soil surface, resulting in numerous shoots of the same plant.

Paratypes. BRAZIL. **Bahia:** Caetité, near Caetité, 01 Mar. 1983, Guedes 2905 (SP); 13°54'S, 41°25'W, 13 Mar. 1981, Silva 194 (HRB, RB); Ituaçu, Morro da Mangabeira, 13°50'S, 41°18'W, 520 m, 20 June 1987, Queiroz *et al.* 1593 (SPF). **Minas Gerais:** Espinosa, 7 km E of Monte Azul, 850 m, 29 Jan. 1991, Taylor *et al.* 1488 (SPF).

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